GTAKE
吉泰科

User Manual

EPC-CM3 CANOPEN

GK800 series High Performance

AC Motor Drives Dedicated

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Chapter 1 Instruction of Dedicated Functions

The dedicated inbuilt CANOPEN functions of GK800- CANOPEN are to provide more rapid control mode for the external control. CAN communication is adopted by CANopen in the physical layer, which has the following advantages and characteristics: ultra-high utilization rate of bus, high-speed data transmission, reliable error handling, and automatic data retransmission after the destruction and so on. CANopen is an upper-layer protocol based on CAN and mainly designed for the following communication objects: PDO (Process Data Objects), Service Data Objects, Time Stamp, SYNC Message, Emergency Message and Network Management Data which includes NMT Messages and Error Control Messages.

Protocol Specifications:

- CAN2.0A
- CANopen DS301 V4.02
- CANopen DS402 V2.0

Support Services

- 8 pairs of PDO（Process Data Objects）
  - TPDO1~TPDO8
  - RPDO1~RPDO8
- SDO（Service Data Objects）
  - Initiate SDO Download
  - Initiate SDO Upload
- SYNC Message
- Emergency Message
- Network Management Data
  - NMT Mode Control
  - NMT Error Control
    - ✓ Node Guarding Protocol
    - ✓ Heartbeat Protocol
      - ✧ Heartbeat Consumer

Support Modes

- DS402 Part
  - Velocity Mode, 2
  - Profile Torque Mode, 4
- Self-defined Part
  - Simple Feed Mode, -1
  - Motor Spindle Orientated Mode, -7

Unsupported Services

- Time Stamp
- Downloading SDO Segment
- Uploading SDO Segment
- Heartbeat Producer

The dedicated Manual should be used together with the User Manual for GK800 Series High Performance AC Motor Drives.

Chapter 2 Modification of Hardware

Communication expanded card (EPC-CM3) dedicated for CANopen should be provided with GK800 series AC motor drives. The definitions of CAN terminals of EPC-CM3 are as shown in Fig. 2-1 and Table1.

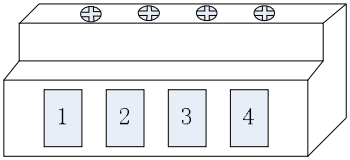


Fig. 2-1 Definitions of CAN Terminals

Table 2-1 Definition and Instruction of Pins

Terminal	Definition	Decription
1	VCC	Power supply terminal /5V
2	DGND	Ground terminal/0V
3	CAN+	CAN_H bus line (dominant high)
4	CAN-	CAN_L bus line (dominant low)

Chapter 3 Simple List of Dedicated Functions

Param.	Name	Scope	Factory Default	Attr
H1-00	Node address of CANopen	1~127	1	×
H1-01	Communication speed of CANopen	0: 10 kbps 1: 20 kbps 2: 50 kbps 3: 125 kbps 4: 250 kbps 5: 500 kbps 6: 1000 kbps	5	×
H1-02	Initial state options of CANopen	0~1	0	×
H1-03	Parameter transmission	0~1	0	×
H1-04	Protective action of internal communication	0~1	0	×

Chapter 4 Specification of Dedicated Functions

H1-00	Node Address of CANopen	Range: 1～127	Factory Default: 1

Node Address of CANopen
1~127: Local Node-ID

H1-01	Communication Speed of CANopen	Range: 0～6	Factory Default: 5

Communication Speed of CANopen *
0: 10 Kbps
1: 20 Kbps
2: 50 Kbps
3: 125 Kbps
4: 250 Kbps
5: 500 Kbps
6: 1000 Kbps

H1-02	Initial State Options of CANopen	Range: 0～1	Factory Default: 0

Initial State Options of CANopen
0: Be subject to CANopen standard
After the boot-up message is sent, the node enters to the PRE-OPERATIONAL state.
1: Automatically enter OPERATIONAL state
After the boot-up message is sent, the node enters to the OPERATIONAL state.

H1-03	Parameter Transmission	Range: 0～1	Factory Default: 0

Parameter Transmission
0: No action
1: Parameter Retransmission
The parameters can be uploaded to the expansion card through the internal communication. Generally, after the modification of some functional parameters via the keypad and the setting of H1-03=1, the latest parameters can be uploaded without power off.

H1-04	Protective Action of Internal Communication	Range: 0～1	Factory Default: 0

Protective Action of Internal Communication
0: Fault action and free stop
1: Shielding the fault

Chapter 5 Overview of CANopen

CANopen is an upper-layer protocol based on the CAN, and is a control network function to make the equipment achieve the purpose of the motion control, just acting as the general management system. CANopen 301 standard (Version 4.02) is EN50325-4. The specifications of CANopen contain the overview of the application layer and communication (CiA DS301), architecture of the programmable units (CiA DS302), cables and connectors (CiADS303-1) as well as SI units and text representations (CiA DS303-2).

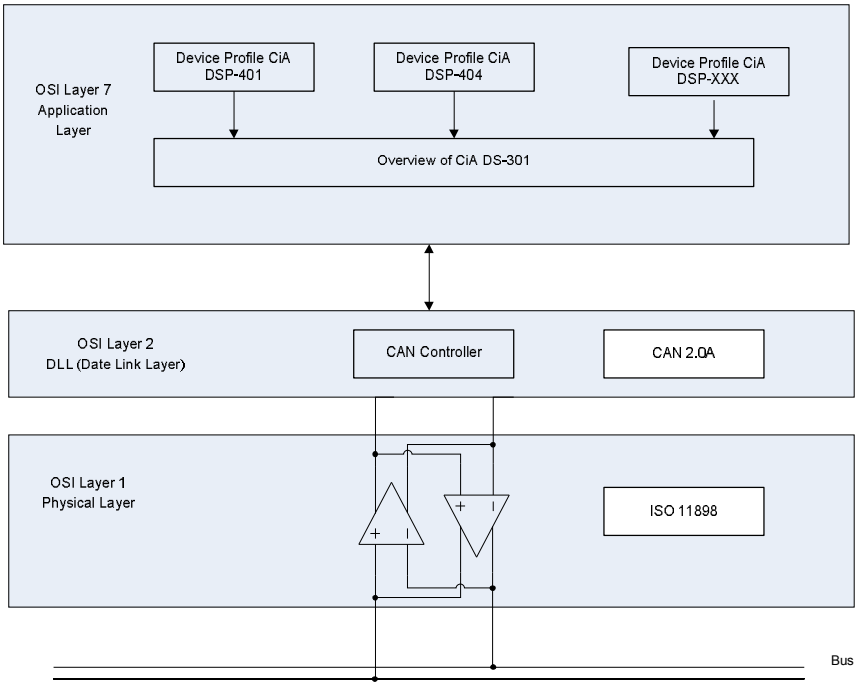


Fig. 5-1 Location Block Diagram of CAN and CANopen Standard in OSI Network Model

5.1 Core of CANopen Protocol

The core of CANopen protocol is shown as follows:

1) The COB-ID(Communication Object Identifiers) are defined with CAN identifier segments (ID10~ID0);
2) The OD (OBJECT DICTIONARY) of equipment is used.

Each node in the CANopen network has an object dictionary which contains all parameters describing the behaviors of this device and its network, namely all the parameters defined by the CANopen specifications which are saved in OD (DS301- communication norm; DS4XX-equipment specification), and provides sufficient space (The object dictionary of a node ranges from 1000 H to 9 FFFH) to the product parameters of the users. The parameters in OD are addressed via 16 bit index and 8 bit sub-index and can be be the data of 1 ~ 4 bytes, so the

largest space occupied by OD is 64K* 256 * 4 = 64MBYTES in theory.
COB - ID includes the FUNCTION segment and address segment (the NODE ID), and 127 stations can be defined in all. These stations are integrated in all kind of communication messages with the COB ID values as the contents, and the IDs of the CANopen communication messages can be expressed in the following formula.

COB-ID = FUNCTION+NODE-ID

The Node-ID shall be defined by the system integrators, for example, it can be set via the toggle switch. The scope of Node - ID is 1 ~ 127("0" is not permitted to be used). On the master station, the function segment refers to the operation contents of the master station over the slave station; the address segment (Node ID) the address of the slave stations operated (station number); on the slave station, the function section shows the response of the slave station to the master station, while the address segment refers to the address of the response slave station (station number). Four types of communication messages are assigned by COB - ID as specified in the CANopen communication models, and its scope is 000 h ~ 7 FFH. The lower the value is, the higher the priority will be.

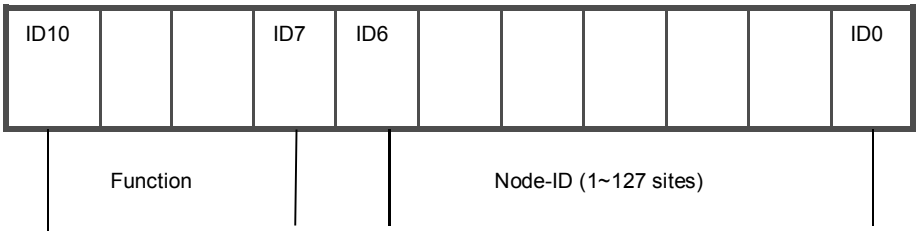


Fig. 5-2 Composition of COB-ID

The COB-IB definitions for the broadcast objects of master/slave connected subnetwork predefined by CANopen and its equal objects are as shown in Table 5-1 and Table 5-2.

Table 5-1 Broadcast Objects of Master/Slave Connected Subnetwork Predefined by CANopen

Broadcast Objects of Master/Slave Connected Subnetwork Predefined by CANopen			
Object	Function Code (ID bits10~7)	COB-ID	Index of Communication Parameters in OD
NMT	0000	000H	-
SYNC	0001	080H	1005H,1006H,1007H
TIME SSTAMP	0010	100H	1012H,1013H

5.2 CANopen Communication Protocol

The CANopen communication protocol includes the following services:

- NMT (Network Management Object)
- SDO (Service Data Objects)
- PDO (Process Data Object)
- EMCY (Emergency Object)
- Node/Life Guard or Heartbeat

5.2.1 NMT (Network Management Object)

The network management message- NMT provides the NMT service by following the master station/slave station architecture. There is only one master station which can be equipped with many slave stations in this architecture. All CANopen nodes have their own NMT states, while the master station can control the states of the slave stations via the NMT messages, with the state flow chart shown as follows:

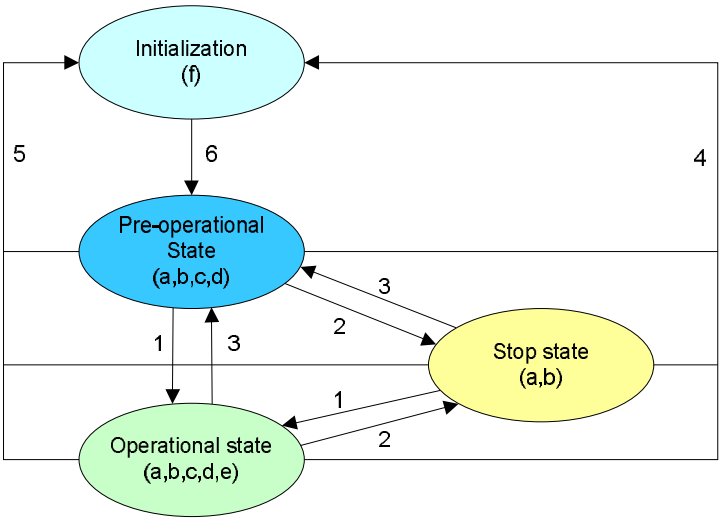


Fig. 5-3 State Transition Diagram of Minimized Boot-Up Nodes for CANopen

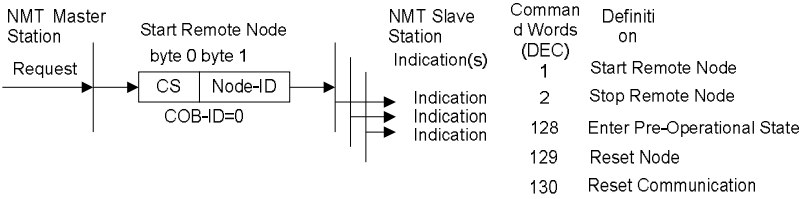
Table 5-2 Opreands in States

		Initialization	Pre-Operational State	Operational State	Stop State
NMT	a		○	○	○
Node Guard	b		○	○	○
SDO	c		○	○	
EMCY	d		○	○	
PDO	e			○	
Boot-up	f	○			

Table 5-3 State Transition NMT Command Words

	Name of Command	Command Words (HEX)
1	Start Remote Node	01
2	Stop Remote Node	02
3	Enter Pre-Operational State	80
4	Reset Node	81
5	Reset Communication	82
6	After the device initialization is over, the system enters to the pre-operational state automatically and then sends the boot-up message.	

The NMTprotocol is shown as follows:



5.2.2 SDO (Service Data Objects)

The SDO (Service Data Objects) are used on both ends, namely clients/servers, and each have permission for the object dictionary. A SDO message contains a set of COB - ID (Required SDO and repsonsive SDO), can be accessible between two nodes. SDO can transfer the data of any size, but once the data size is more than 4 bytes, then the segment transmission means should be used, and the last segment should consist of a finish instruction.

The object dictionary is the group object of CANopen node, and each node has its own object dictionary.The object dictionary contains many parameters which describe its supporting parameter properties and values. The SDO is accessed by means of indexes and sub-indexes. Each object has a single index value, but may have multiple sub-indexes if necessary.The SDO requirement and response message architecture request is shown as follows:

Table 5-4 Definitions of SDO Commands

Name		Byte0								Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
		7	6	5	4	3	2	1	0	Index	Index	Index	Data	Data	Data	Data
		Command								L	H	Sub	LL	LH	HL	HH
Regional	Client	0	0	1	-	N		E	S							
Downloading	Server	0	1	1	-	-	-	-	-							
Regional	Client	0	1	0	-	-	-	-	-							
Uploading	Server	0	1	0	-	N		E	S							
Stop	Client	1	0	0	-	-	-	-	-							
Transmission	Server	1	0	0	-	-	-	-	-							

N: Not used number of bytes,
E: Common (0) / Send (1),
S: Symbol of data size

5.2.3 PDO (Process Data Object)

The PDO (Process Data Objects) are used on producers/consumers, and each network node can listen to messages from the transmission nodes, and also judge whether to deal with them or not after receipt. The PDO data transfer can be finished in one-to-one or one-to-many manner. The size of the data to be transmitted shall be within the range of 1~ 8 bytes (for example, a PDO can transfer up to 64 digital I/O values or 4 AD values of 16 bits). The PDO communication shall not be subject to any agreement. The PDO data contents are only defined by its CAN ID, assuming that the data contents of this PDO are known by producers and consumers.
The contents of the PDO messages are predefined (or configured in the process of network startup), and the mapping of the application objects to the PDO is described in the device object dictionary. If the devices (producers and consumers) support the variable PDO mapping, then the PDO mapping parameters can be configured with the SDO messages.
Every PDO message contains the transmission PDO (TPDO) and receiving PDO (RPDO) messages, and its transmission modes are defined in the PDO communication parameter index (The first group of PDO messages received is located in 1400 h index, and the first group of the PDO messages sent is located in the index 1800 h). The transmission modes are listed in the following table.

Table 5-5 Definition of PDO TransmissionType

Transmission Type	Conditions to Trigger PDO （B=both needed O=one or both）			PDO Transmission
	SYNC	RTR	Event	
0	B	-	B	Synchro, non-cyclical
1-240	O	-	-	Synchro, cyclical
241-251	-	-	-	Reserved
252	B	B	-	Synchro, after RTR
253	-	O	-	Asynchronous, after RTR
254	-	O	O	Asynchronous, specific events related to manufacturers
255	-	O	O	Asynchronous, specific events related to equipement sub-protocol

NOTE:
- SYNC – Receive the SYNC-object.
- RTR －Receive the remote frame.
- Event –For example, value change or interruption of timer.
- Transmission Type: For 1~240，the figure stands for the value of the SYNC object between PDOs.

For example, provided that the second map of the TPDO is as shown as follows (it is described with the object dictionary index 1A01H in CANopen).

Object1A01H : Second TPDO Map		
Serieal No.	Value	Meanings
0	2	Two objects mapped to PDO
1	60410010H	Object, 6041H；sub-index, 00H，consisting of 16 bits
2	60610008H	Object, 6061H；sub-index, 00H，consisting of 8 bits

In the definitions of the equipment sub-protocol (CiA DSP - 402) for CANopen Drives and Motion Control module, the one with the object of 6041 H and the sub-index of 00 H refers to the Status Word, while the one with the object of 6061 H and the sub-index of 00H refers to Modes of Operation Display.
If the PDO message issent (it may be triggered in ways of the input change, timer interruption or remote request frame and so on, and its transmission type is consistent to that of the PDO; it can be found in the sub-index 2 of the object 1801H), then the message consists of 3 bytes of data, with the format shown as follows:

PDO-producer →PDO-consumer(s)

COB-ID	Byte0	Byte1	Byte2
280H+Node-ID	Status Word-L	Status Word-H	Modes Of Operation Display

The PDO content can be changed by changing the content of the object 1 A01H (if the node support (variable PDO mapping)).
Please note that the LSB (Little Endian) of the multi-byte shall be always sent first in the CANopen.
The data more than 8 bytes are not allowed to be mapped to a PDO.
MPDO multiplexor (PDO), defined in the CANopen Application Layer and the Communication Profile (CiA DS 301 V 4.02), allows a PDO to transmit a large number of variables through the sources contained in the data bytes ofthe message or the indexes and sub-indexes in the destination nodes- ID and OD.

5.2.4 EMCY (Emergency Object)

When there is an internal error in the hardware, an emergency object will be triggered. The emergency object is transmitted only when there is an error in the hardware, and is used as a false alarm interrupt message. The emergency object is 8 bytes of data and is expressed as follows:

Table 5-6 Definition of EMCYObject

Byte	0	1	2	3	4	5	6	7
Content	Emergency Error Code		Error register (Object 1001H)	Manufacturer specific Error Field				

The definition of the emergency object message is shown in Appedix 2 CANopen Fault Codes.

5.2.5 Node/Life Guard or Heartbeat

The MNT master node can check the current state of each node through the node protection service which is significant especially when these nodes send no data.
The process that the NMT-Master mode sends the remote frame (no data) is shown as follows:

NMT-Master→NMT-Slave

COB-ID
700H+Node_ID

The NMT-Slave nodes send the following message response:

NMT-Master ← NMT-Slave

COB-ID	Byte0
700H+Node_ID	Bit 7: toggle; Bit6-0: state

The data part contains a toggle bit (bit 7) which should be alternatively set to “0” or “1” while the node makes a protective response. The toggle bit is set to “0” at the first node protective request. Bits 0~6 mean the node states and can be expressed with the values intable 5-7.

Table 5-7 Definition of NMT-Slave Node States

Value	State
0	Initialising
1	Disconnected *
2	Connecting *
3	Preparing *
4	Stopped
5	Operational
127	Pre-operational

NOTE: The states marked with "*" are only provided by the nodes supporting the extendable boot-up function. Please note that State 0 shall not appear in the node protective response, because a node shall not respond to the node protective message in this state.

As well, a node can be configured to the periodic Heartbeat message.

Heartbeat Producer → Consumer(s)

COB-ID	Byte0
700H+Node_ID	State

The states can be shown as in the table below:

Table 5-8 Definition of NMT-Slave Node States

Value	State
0	Boot-up
4	Stopping
5	Operational
127	Pre-operational

After a Heartbeat node is started, its boot-up message is the first Heartbeat message.The heartbeat consumers are usually NMT Master nodes which shall set a timeout value for each heartbeat node so that the corresponding action will be taken when the timeout occurrs.
A Node can not be able to support both the Node Guarding and Heartbeat protocols at the same time.

5.3 Introduction to DSP-402 Motion Control

5.3.1 Overall Architecture

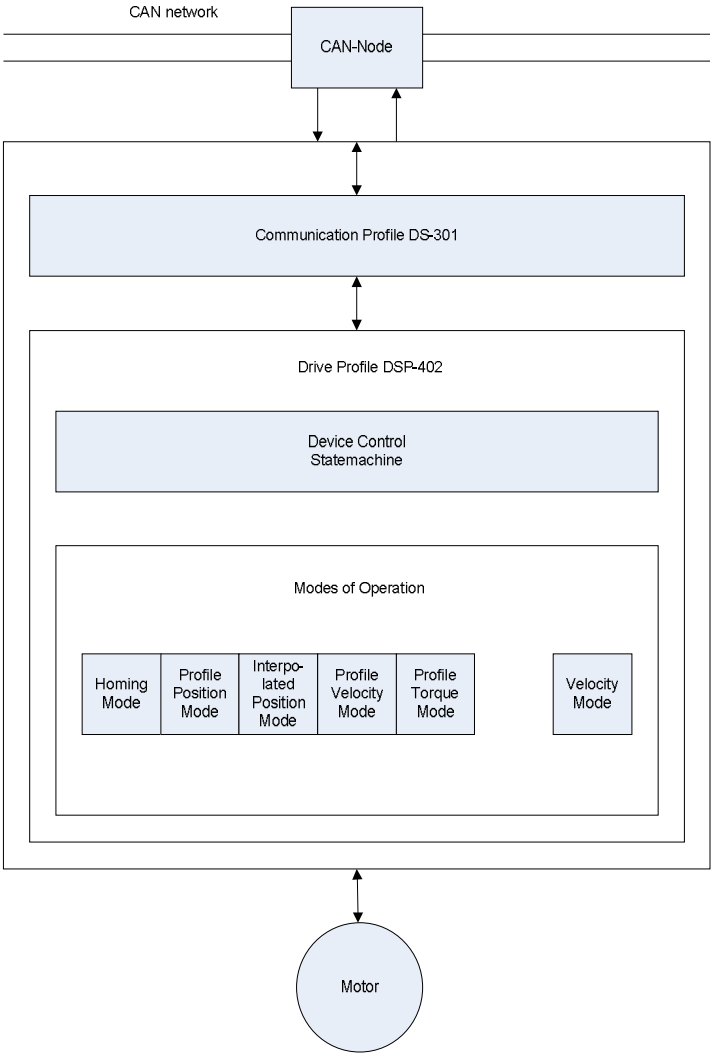


Fig 3 Diagram of Overall Architecture

5.3.2 Driver Statemachine

Unlike most other equipment sub-protocols, the driver sub-protocol gives an accurate description to its characteristics. This sub-protocol not only defines the operational mode and the corresponding parameter of the driver, but also defines a statemachine used to control the driver.
The statemachine controls the driver via command word (Index 6040 H), as shown in Figure 5. All the states in the statemachine are indicataed by status words (Index 6041H).
The state of the driver is changed only through some instructions on Object 6040 H or internal events. For example, only when the driver is in allowable running state, can the point-to-point movement be allowed to trigger.

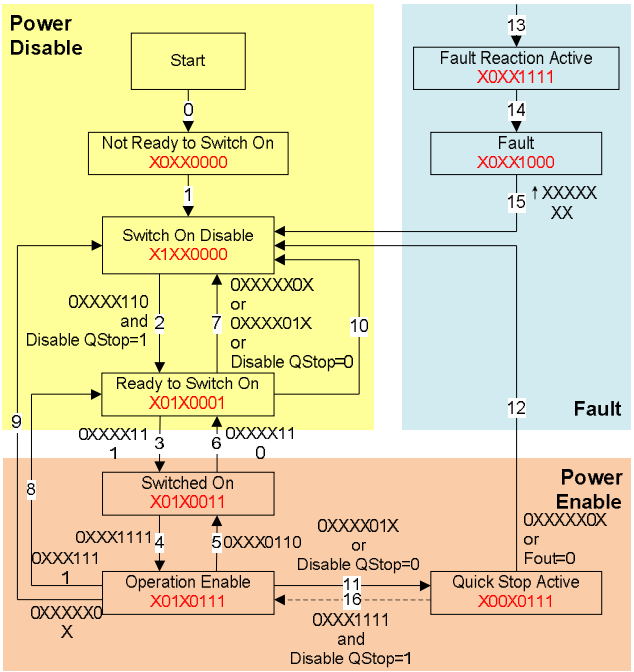


Fig 5 State Transition Diagram

As shown in Fig 5, the driver has the following states:

- **Not Ready to Switch On**
  Low-voltage power supply of the controller is switched on (such as ±15V, 5V);
  The driver is being initialized and has carried out the internal self-check;
  If there is a braking device, then it is also activated;
  Driver functions disabled
- **Switch On Disabled**
  The driver has been initialized;
  Driver parameters need to be set;
  Driver parameters changeable;

No high voltage supplied to the driver (such as for the security considerations or other reasons);
Driver functions disabled

- **Ready to Switch On**
  The high voltage is supplied to the driver;
  The power amplifier gets ready to work;
  Driver parameters changeable;
  Driver functions disabled
- **Operation Enable**
  No error;
  The drive function is enabled aiming at a special operational mode, and the motor is started;
  The dynamic parameter settings for the driver can be done in the way of on-the-fly.
- **Quick Stop Active**
  Driver parameters changeable;
  Emergency stop function is active;
  The driver function is active and simultaneously the motor is started.

  NOTE: If “Quick-Stop-Option-Code” is “5” (Stay in Quick-Stop), then the Quick-Stop-State is kept and it can be switched to“Operation Enable” via the“Enable Operation” command.

- **Fault Reaction Active**
  Driver parameters changeable;
  There is nonfatal fault in the driver;
  Emergency stop function is conducted;
  The driver function is active and simultaneously the motor is started.

- **Fault**
  Driver parameters changeable;
  The driver goes wrong;
  Driver functions disabled

5.3.3 State Transition of Driver

The state transition reason includes the internal events of the driver or the control word command from the master control.

- State Transition 0: Startup➔Not Ready to Switch On
  Event: Reset
  Function: Self-check and/or initialization of driver

- State Transition 1: Not Ready to Switch On ➔ Switch On Disabled
  Event: Successful self-check and/or initialization of driver
  Function: To activate communication and process data monitoring

- State Transition 2: Switch On Disabled ➔ Ready to Switch On
  Event: Receiving a “Shutdown”command from the master control
  Function: no

- State Transition 3: Ready to Switch On ➔ Switched On
  Event: Receiving a “Switch On”command from the master control
  Function: To swtich on the power supply

- State Transition 4: Switched On ➔ Operation Enable

Event: Receiving a “Enable Operation”command from the master control
Function: To enable the driver function

- State Transition 5: Operation Enable ➔ Switched On
  Event: Receiving a “Disable Operation” command from the master control
  Function: To disable the operation of driver

- State Transition 6: Switched On ➔ Ready to Switch On
  Event: Receiving a “Shutdown”command from the master control
  Function: To switch off the power supply of driver

- State Transition 7: Ready to Switch On ➔ Switch On Disable
  Event: Receiving a “Quick Stop” command from the master control
  Function: No

- State Transition 8: Operation Enable ➔Ready to Switch On
  Event: Receiving a “Shutdown”command from the master control
  Function: The power supply is cut off at once and the motor stops automatically if there is no brake

- State Transition 9: Operation Enable ➔Switch On Disalbe
  Event: Receiving a “Disable Voltage” command from the master control
  Function: The high-voltage power supply is cut off at once and the motor stops automatically if there is no brake

- State Transition 10: Switched On ➔Switch On Disalbe
  Event: Receiving a “Disable Voltage” command from the master control
  Function: The power supply is cut off at once and the motor stops automatically if there is no brake

- State Transition 11: Operation Enable ➔Quick Stop Active
  Event: Receiving a “Quick Stop” command from the master control
  Function: To execuate an emergency stop command

- State Transition 12: Quick Stop Active ➔Switch On Disabled
  Event: “Quick Stop” is completed or a “Quick Stop” command is received from the master control
  Function: To switch off the power supply

- State Transition 13: All States➔Fault Reaction Active
  Event: Critical fault in the driver
  Function: Execute the corresponding fault response

- State Transition 14: Fault Reaction Active ➔Fault
  Event: Fault response over
  Function: Driver function disabled, power supply shut off possibly

- State Transition 15: Fault ➔Switch On Disabled
  Event: Receiving a “Fault Reset” command from the master control
  Function: If there is a fault, the current fault of the driver is reset; later, the master control will clear off the “Fault Reset” bit in the control work and the driver is not in “Fault” state.

- State Transition 16: Quick Stop Active ➔Operation Enable
  Event: Receiving an “Enable Operation” command from the master control. For this transition, Quick-Stop-Option-Code should be 5, 6, 7 or 8.
  Function: Driver function enabled

The methods for interrupting the state transition are listed in Table 5-9.

Table 5-9 Objects of Option Codes for Interrupting State Transition

Index	Name	State Transition
605BH	Shutdown Option Code	8
605CH	Disable Operation Option Code	5
605AH	Quick Stop Option Code	11
605EH	Fault Reaction Option Code	13

5.3.4 Modes of Operation

The behaviors of the driver are defined by the operation modes (Modes of Operation, Index 6060H, Write Only; Modes of Operation Display, Index 6061 H, Read Only), and the standard modes defined are shown as follows. Please refer to the CiA Specification DSP – 402 for the details of operation modes.

- Standard Position Mode (1，Profile Position Mode)
  In this position mode of the driver, the following parameters can be set, including the speed, position, acceleration, limits as well as the displacement according to the desired trajectory.

- Velocity Mode (2，Velocity Mode)
  In this mode, the speed is controlled by the inverter, and there are speed limitation and slope function. This mode is generally used when there is no speed sensor.

- Standard Velocity Mode (3，Profile Velocity Mode)
  The speed of the driver is controlled in the standard velocity mode without he designated location, and this mode supports the limit function and the track production.

- Standard Torque Mode (4，Profile Torque Mode)
  This torque control defines all the parameters related to the torque.

- Homing Mode (6，Homing Mode）
  This mode defines several methods for finding original locations (also defines the reference points, data and zero).

- Interpolated Position Mode (7, Interpolated Position Mode)
  The mode describes the single axis interpolation and the travel of spatial linkage axis-time interpolation. Synchronous machines and interpolation data cache are included.

There are many different adjusters in the drivers, and different parameters should be used for different algorithms for each adjuster. Coupled with the diverse technical solutions, all the adjusters can not be defined in a standardized way. If the parameters of the adjuster should be set through the network, then the objects defined by the manufacturers must be used.

5.3.5 Device Control

The Device Control (Index 6040H) can start or stop the driver and commands specified in several modes. These commands are executed by the statemachine. The meanings of the control words are shown in Table 10.

MSB | LSB

Bit 15	Bit 14	Bit 13	Bit 12	Bit 14	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Table 5-10 Bit Definition of Control Words

Bit	Name	Compulsive or Not
0	Switch On	√
1	Disable Voltage	√
2	Quick Stop	√
3	Enable Operation	√
4	Operation Mode Specific	
5	Operation Mode Specific	
6	Operation Mode Specific	
7	Reset Fault	√
8	Halt	
9	Reserved	
10	Reserved	
11	Manufacturer Specific	
12	Manufacturer Specific	
13	Manufacturer Specific	
14	Manufacturer Specific	
15	Manufacturer Specific	

The commands triggering the device control in the definition of the control word bit are listed in Table 5-11.

Table 5-11 Device Control Command

Control Word	Bit7	Bit3	Bit2	Bit1	Bit0	Transition of Statemachine
Command	Fault Reset	Enable Operation	Quick Stop	Disable Voltage	Switch On	
Shutdown	0	×	1	1	0	2,6,8
Switch On	0	×	1	1	1	3
Disable Voltage	0	×	×	0	×	7,9,10,12
Quick Stop	0	×	0	1	×	7,10,11
Disable Operation	0	0	1	1	1	5
Enable Operation	0	1	1	1	1	4,16
Fault Reset		×	×	×	×	15

The bit definitions in modes (Bit 4~ Bit 6) are shown in Table 5-12

Table 5-12 “Mode specific” Bits in Control Word

Bit	Mode					
	Velocity Mode	Standard Position Mode	Standard Velocity Mode	Stanard Torque Mode	Homing Mode	Interpolated Position Mode
4	RFG Disabled	New position point	Reserved	Reserved	Homing operation	Enabled position interpolation
5	RFG Stop	Change position at once	Reserved	Reserved	Reserved	Reserved
6	RFG for zero	0: Absolute motion 1: Relative motion	Reserved	Reserved	Reserved	Reserved
8	Pause	Pause	Pause	Pause	Pause	Pause

RFG: **R**unning up **F**requency **G**enerator
Pause: To interrupt the operation of the driver and then continue to run after releasing.

5.3.6 Status Word

Status word (Status Word, Index 6041H) refers to the current status of the driver and is always mapped to the second byte of the actual message, and the bit definitions of the status words are shown in the table below.

MSB LSB

Bit 15	Bit 14	Bit 13	Bit 12	Bit 14	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Table 5-13 Bit Definitions of Status Words

Bit	Name	Compulsive or Not
0	Ready to Switch On	√
1	Switched On	√
2	Operation Enabled	√
3	Fault	√
4	Voltage Disabled	√
5	Quick Stop	√
6	Switch On Disabled	√
7	Warning	
8	Manufacturer Specific	
9	Remote	√
10	Target Reached	√
11	Internal Limit Active	√
12	Operation Mode Specific	
13	Operation Mode Specific	
14	Manufacturer Specific	
15	Manufacturer Specific	

The bit meanings of the state are shown in Table 5-14.

Table 5-14 Bit Meanings in States

State	Bit6	Bit5	Bit3	Bit2	Bit1	Bit0
	Switch On Disable	Quick Stop	Fault	Operation Enable	Switched On	Ready to Switch On
Not Ready to Switch On	0	×	0	0	0	0
Switch On Disabled	1	×	0	0	0	0
Ready to Switch On	0	1	0	0	0	1
Switched On	0	1	0	0	1	1
Operation Enabled	0	1	0	1	1	1
Fault	0	×	1	1	1	1
Fault Reaction Active	0	×	1	1	1	1
Quick Stop Active	0	0	0	1	1	1

Bit 4: Voltage Disable
When the Voltage Disable bit is in zero clearing state, it means that the Disable Voltage request has come into effect.
Bit 5: Quick Stop
Upon resetting, this bit means that the driver responds to the Quick Stop request, and Bit 0, 1 and 2 in status word must be set to be “1” in order to restore the driver.
Bit7: Warning
This bit refers to a warning of the driver, which means no error, but it should stand for a state, such as the temperature limitation, operation refusal. At this moment, the status of the driver does not change. The reason for the warning can be found out through reading fault codes, and this bit can be set and reset by the equipment.
Bit8, Bit14 and Bit15: Manufacturer Specific
This bit can be used for the user-defined function of the driver manufacturer.
Bit9: Remote
If Bit 9 is set, then the parameter can be modified via CAN network and the driver can receive the control command; if this bit is reset, then the driver executes the local command, and cannot execute the remote command. The message sent by the driver includes the local actual value of the driver, such as Position Actual Value. In the local mode, the driver can also receive the SDO command.
Bit10 Target Reached
If Bit 10 is set for the driver, then it means that a setting point is reached (torque, velocity, position, etc.), and this bit can be changed through the change of a software target value.
When the emergency stop operation is over and the driver pauses, if Quickstop Option Code is 5, 6, 7or 8， then this bit should be set.
If the pause takes effect and the driver pauses, this bit is also set.
Bit 11: internal_limit_active
This bit enabled means that the internal limitation of the driver is activated (such as the limitation of position range).

Bit12 and Bit13 are assigned operating modes, as shown in the table below:

Table 5-15 Indicating Bit of Operating Mode

Bit	Velocity Mode	Profile Position Mode	Profile Velocity Mode	Profile Torque Mode	Homing Mode	Interpol. Position Mode
12	Reserved	Setting point confirmed	Velocity=0	Reserved	Receiving at original point	Ip-Mode active
13	Reserved	Following error	Max. sliding error	Reserved	Finding original point error	Reserved

NOTE:
All bits show the actual/current status of the driver, and no bit is locked.

Chapter 6 CANopen Communication and Inverter Control

6.1 Operation Steps

When the CANopen control inverter is required to be used, it should be configured according to the following steps:

1) Hardware wiring: Refer to the Hardware Wiring in Chapter Two. Connect CAN+ and CAN-. If the group networkcontrol is required, then the terminal resistants should be connected at two termnals if necessary. In fact, there is a toggle switch S2 for the terminal resistant selection on the CANopen control card, and the selective terminal resistant can be confirmed via “ON” or “OFF” button;
2) Parameter Settings of Driver
   a) To set the control mode (A0-09), motor parameter (Group d0) and coder parameter (Group d6, if the external coder is not used, then d6-00 should be still set to “1”). NOTE: The settings above are the parameters under the condition of “Motor 1”, namely A0-08=0 (Default);
   b) Parameter identification: Refer to Manual of GK800 Inverter in detail. It just refers to the identification of the first use of new motor;
   c) Driver reset or parameter setting H1-02=1, it is recommended to operate it after the driver is restarted;
   d) Setup of frequency main setting mode: b0-01=9，select the communication input;
   e) Setup of operation command setting mode: b1-00=2，select the communication control;
   f) Setup of electric/braking torque limit mode: d2-12=5， d2-13=5， select the communication setup;
   g) Setup of FWD/REV speed limit mode for torque control: d2-19=5，d2-20=5，select the communication setup;
   h) Setup of CANopen Station Number: The desired station number for H1-00 should be set within the range of 1～127. The driver should be restarted.
   i) Setup of CANopen baud rate: The baud rate for H1-01 should be set within the range of 0～6, with the specific value as shown in Chapter Four. The driver should be restarted.
3) CANopen Communication
   a) The register value of the corresponding index via the SDO protocol;
   b) NMT control enters the “Operational” state from the node;
   c) The inverter is controlled through using PDo to write in the control words and other parameters.

6.2 Operation Mode

The driver mainly supports the following operation modes:

- Velocity Mode, 2
- Profile Torque Mode, 4
- Simple Feed Mode, -1
- Motor Spindle Orientation Mode, -7.

Simple feed mode and motor spindle orientation mode belong to the position control which is valid only when the "Closed-loop vector control (Index 2002 H, Function Code A0-09=3)". Therefore, the appropriate PG card should be chosen. The parameter settings and mode instruction in the position control mode are as shown in the Introduction part of Group F4 Position Control” in User Manual for GK800 Series High Performance AC Motor Drives. The common parameters are shown in Table 15 below, are set in the simple feed mode and motor spindle orientation mode as required.

It is important to note that some parameters cannot be modified when the motor is running. For more detailed description of object, please refer to the parameter instruction of the function codes in function code, corresponding to the “Function Code” column in the Appendix “Object Dictioary”, in the User Manual for GK800 Series High Performance AC Motor Drives

Table 5-16 Common Parameters of Position Control

Object			Function Code	Name	Range	Factory Default
Index	Sub-Index	Length				
2032	00	2	F4-01	Positioning completion width	0~3000	10
2033	00	2	F4-02	Positioning completion time	0.000S~40.000S	0.200S
2034	00	2	F4-03	Position loop gain	0.000~40.000	1.000

6.2.1 Velocity Mode

The following parameters should be set in this mode:

Table 5-17 Related Parameters in Velocity Mode

Object			Name	Value	Meanings
Index	Sub-Index	Length			
6060	00	1	Modes of Operation	2	Mode selection
6042	00	2	Target Velocity	User defined	Target velocity
6046	01	4	Velocity Amount Min	User defined	Lower limit of velocity
6046	02	4	Velocity Amount Max	User defined	Upper limit of velocity
604F	00	4	Ramp Function Time	User defined	Acceleration time
6050	00	4	Slow Down Time	User defined	Deceleration time
6051	00	4	Quick Stop Time	User defined	Deceleration time of emergency stop
2005	01	2	Frequency MAX.	User defined	Max frequency setting
2013	01	2	Limt Torque Drive	User defined	Electric torque limit
2013	02	2	Limt Torque Break	User defined	Braking torque limit

When the control word (Index 6040 H) is set to 007 FH, the motor starts to run according to the parameters mentioned in Table 17 above; set to 005 FH, the current speed will be locked. In the table, the maximum frequency setting (Index 2005, Sub-index 01) is in 0.01 Hz, namely “5000”for “50.00 Hz”; the torque limit (Index 2013, sub index01) setting is in 0.1%, namely “1000” for “100%”.

The conversion between velocity and frequency can be realized through the following formula

$$n = f \times \frac{120}{p}$$

In the formula above,

n—— Revolving speed in RPM

f——Frequency in Hz

p——Motor poles

For examples:

For the four-pole motor rotating in the forward direction at 30Hz, its revolving speed is: 30×120÷4=900(RPM)

For the six-pole motor rotating in the reverse direction at 20Hz, its revolving speed is: 20×120÷6=-400(RPM)

“-400” is transmitted in the complement form, so the value of Index 6042H is set to FE70H.

6.2.2 Torque Mode (Profile Torque Mode)

The following parameters should be set in this mode:

Table 5-18 Related Parameters inTorque Mode

Object			Name	Value	Meanings
Index	Sub-Index	Length			

6060	00	1	Modes of Operation	4	Mode selection
6071	00	2	Target Torque	User defined	Target torque
6072	00	2	Max Torque	User defined	Max torque limit
2021	00	2	Torque Acceleration Deceleration Time	User defined	Torque acceleration/deceleration time
2022	01	2	Limt Speed Forward	User defined	Limit of forard rotating speed
2022	02	2	Limt Speed Reverse	User defined	Limit of reverse rotating speed

When the control word (Index 6040 H) is set to 000 FH, the motor starts to run according to the parameters mentioned in Table 18 above and the “Target torque” is expressed with the relative percent of “Rated Torque” in 0.1%, namely “1000” for “100%”, “-1000” for “-100%”. The speed limit is in 0.01 Hz, namely “5000”for “50Hz”. The acceleration time is in 0.01s, namely “10” for “0.10s”.

6.2.3 Simple Feed Mode

The following parameters should be set in this mode:

Table 5-19 Related Parameters in simple feed mode

Object			Name	Value	Meanings
Index	Sub-Index	Length			
6060	00	1	Modes of Operation	-1（FFH）	Mode selection
2060	00	4	Target Position	User defined	Target position
6042	00	2	Target Velocity	User defined	Target speed
604F	00	4	Ramp Function Time	User defined	Acceleration time
6050	00	4	Slow Down Time	User defined	Deceleration time

When the control word (Index 6040 H) is set to 000 FH, the motor starts to run at 0 Hz (the motor is locked); when it is set to 080FH, the motor starts to run at the target speed in the forward direction mentioned in Table 18 above; when it is set to 100FH, the motor runs in the reverse direction.

NOTE: The direction signal control command is invalid in rising edge.

6.2.4 Motor Spindle Orientation Mode

The following parameters should be set in this mode:

Table 20 Related Parameters in motor spindle orientation mode

Object			Name	Value	Meanings
Index	Sub-Index	Length			
6060	00	1	Modes of Operation	-7（F9H）	Mode selection
2050	00	2	Target Principal Axis	User defined	Positioning location of spindle
2051	00	2	Direction	User defined	Positioning direction of spindle
2052	00	2	Max Speed	User defined	Positioning speed of spindle
2053	00	2	Decelerate Time	User defined	Positioning deceleration time of spindle

When the control word (Index 6040 H) is set to 000 FH, the motor starts to run in the Velocity Mode (Modes of Operation =2); when it is set to 080FH, the motor starts to enable the spindle positioning function according to the parameters mentioned in Table 20 above.

NOTE:

1. The spindle positioning command is invalid in high level.
2. The positioning direction, speed and deleration time of the spindle should be modified before the motor starts to run.

6.3 PDO Mapping

The first four PDOs are the COB - ID by default, and have been already enabled by default, while two rear PDOs are not specified (80000000 H) and inactive, and if they need to be activated, the correct COB - ID values should be set in the corresponding PDO communication parameters.

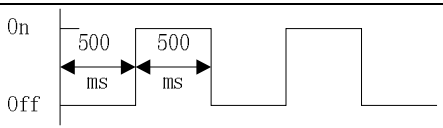
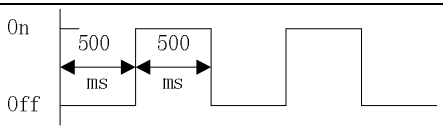
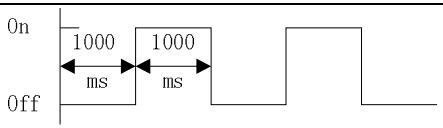
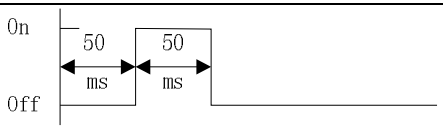
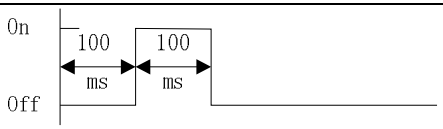
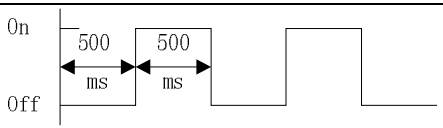
Table 5-21 PDO Mapping Parameters

	No.	COB-ID	Mapping Index (HEX)	Mapping Name	Description
RPDO	1	200H+Node_ID	6040	Control Word	Control word
	2	300H+Node_ID	6040	Control Word	
			6060	Mode of Operation	Operation mode
	3	400H+Node_ID	6040	Control Word	
			6042	Target Velocity	Target speed（VL）
	4	500H+Node_ID	6040	Control Word	
			6071	Target Torque	Target torque
	5	80000000H	6040	Control Word	
			2050	Target Principal Axis	Spindle positioning location
	6	80000000H	6040	Control Word	
			2060	Target Position	Target position
TPDO	1	180H+Node_ID	6060	Status Word	Status word
	2	280H+Node_ID	6040	Status Word	
			6061	Mode of Operation Display	Current operation mode
	3	380H+Node_ID	6040	Status Word	
			6044	Actual Velocity	Current speed (VL)
	4	480H+Node_ID	6040	Status Word	
			6077	Actual Torque	Current torque
	5	80000000H	6040	Status Word	
			2054	Actual Principal Axis	Actual positioning location of spindle
	6	80000000H	6040	Status Word	
			2063	Actual Position	Current location

Both RPDO7~8 and TPDO7～8 are not specified.

6.4 LED Indicator Lights

The LED indicator lights of CANopen include RUN, ST, CN and ERR indicator lights, which separately mean CPU running, slave station status, communication indication and fault. Except the ERR indicator is red light, the rest are green lights, with the indication definitions shown as follows:

LED Code	LED Status	Description	Triggering Condition
RUN	Off		CPU failing to run
	Flash		CPU running
ST	Off		CANopen in initialization state
	Flash		CANopen in pre-operational state
	Flash		CANopen in stopping state
	Normally On		CANopen in operational state
CN	Off		No message received
	A flash		One or more messages sent or received
ERR	Off		No fault
	A flash		One or more messages received are lost
	Flash		Internal communication interrupted

Appendix 1: Object Dictionary (Factory Default)

DS301 Parameter Table

Index (HEX)	Sub-Index (HEX)	Access Permission	Type	Default (HEX)	Unit	Description
1000	00	RO	U32	00010192		Equipment Type
1001	00	RO	U8	00		Faulty register
1002	00	RO	U32	00000000		Manufacturer state register
1005	00	RW	U32	00000080		Sync message COBID
1008	00	RO	U32	4B415447		Equipment name GTAK)
1009	00	RO	U32	30304230		Hardware version (B00)
100A	00	RO	U32	36303038		Software version (8006)
100C	00	RW	U16	0000	ms	Node protection
100D	00	RW	U8	00		Life protection
1014	00	RW	U32	00000081		Emergency message COBID
1015	00	RW	U16	0000	0.1ms	Disabled time
1017	00	RW	U16	0000	ms	Generation cycle of heartbeat message
1400	00	RO	U8	02		RPDO1 Communication parameter
	01	RW	U32	00000201		COBID
	02	RW	U8	FF		Transfer type
1401	00	RO	U8	02		RPDO2 Communication parameter
	01	RW	U32	00000301		COBID
	02	RW	U8	FF		Transfer type
1402	00	RO	U8	02		RPDO3 Communication parameter
	01	RW	U32	00000401		COBID
	02	RW	U8	FF		Transfer type
1403	00	RO	U8	02		RPDO4 Communication parameter
	01	RW	U32	00000501		COBID
	02	RW	U8	FF		Transfer type
1404	00	RO	U8	02		RPDO5 Communication parameter
	01	RW	U32	80000000		COBID
	02	RW	U8	FF		Transfer type
1405	00	RO	U8	02		RPDO6 Communication parameter
	01	RW	U32	80000000		COBID

	02	RW	U8	FF		Transfer type
1406	00	RO	U8	02		RPDO7 Communication parameter
	01	RW	U32	80000000		COBID
	02	RW	U8	FF		Transfer type
1407	00	RO	U8	02		RPDO8 Communication parameter
	01	RW	U32	80000000		COBID
	02	RW	U8	FF		Transfer type
1600	00	RW	U8	01		RPDO1Mapping parameter
	01	RW	U32	60400010		First mapping object
	02	RW	U32	0		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object
	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object
1601	00	RW	U8	02		Number of mapping objects
	01	RW	U32	60400010		First mapping object
	02	RW	U32	60600008		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object
	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object
1602	00	RW	U8	02		RPDO2Mapping parameter
	01	RW	U32	60400010		First mapping object
	02	RW	U32	60420010		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object
	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object
1603	00	RW	U8	02		RPDO3Mapping parameter
	01	RW	U32	60400010		First mapping object
	02	RW	U32	60710010		Second mapping object
1604	00	RW	U8	02		RPDO4Mapping parameter
	01	RW	U32	60400010		First mapping object

	02	RW	U32	20500010		Second mapping object
1605	00	RW	U8	02		RPDO5Mapping parameter
	01	RW	U32	60400010		First mapping object
	02	RW	U32	20600020		RPDO6Mapping parameter
1606	00	RW	U8	00		RPDO7Mapping parameter
	01	RW	U32	0		First mapping object
	02	RW	U32	0		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object
	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object
1607	00	RW	U8	00		RPDO8Mapping parameter
	01	RW	U32	0		First mapping object
	02	RW	U32	0		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object
	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object
1800	00	RO	U8	05		TPDO1 Communication parameter
	01	RW	U32	00000181		COBID
	02	RW	U8	FF		Transfer Type
	03	RW	U16	0000	0.1ms	Disabled time
	04	RW	U8	00		Reserved
	05	RW	U16	0000		Timing time
1801	00	RO	U8	05		TPDO2 Communication parameter
	01	RW	U32	00000281		COBID
	02	RW	U8	FF		Transfer Type
	03	RW	U16	0000	0.1ms	Disabled time
	04	RW	U8	00		Reserved
	05	RW	U16	0000	0.1ms	Timing time
1802	00	RO	U8	05		TPDO3 Communication parameter
	01	RW	U32	00000381		COBID
	02	RW	U8	FF		Transfer Type
	03	RW	U16	0000	0.1ms	Disabled time

	04	RW	U8	00		Reserved
	05	RW	U16	0000	0.1ms	Timing time
1803	00	RO	U8	05		TPDO4 Communication parameter
	01	RW	U32	00000481		COBID
	02	RW	U8	FF		Transfer Type
	03	RW	U16	0000	0.1ms	Disabled time
	04	RW	U8	00		Reserved
	05	RW	U16	0000	0.1ms	Timing time
1804	00	RO	U8	05		TPDO5 Communication parameter
	01	RW	U32	80000000		COBID
	02	RW	U8	FF		Transfer Type
	03	RW	U16	0000	0.1ms	Disabled time
	04	RW	U8	00		Reserved
	05	RW	U16	0000		Timing time
1805	00	RO	U8	05		TPDO6 Communication parameter
	01	RW	U32	80000000		COBID
	02	RW	U8	FF		Transfer Type
	03	RW	U16	0000	0.1ms	Disabled time
	04	RW	U8	00		Reserved
	05	RW	U16	0000		Timing time
1806	00	RO	U8	05		TPDO7 Communication parameter
	01	RW	U32	80000000		COBID
	02	RW	U8	FF		Transfer Type
	03	RW	U16	0000	0.1ms	Disabled time
	04	RW	U8	00		Reserved
	05	RW	U16	0000	0.1ms	Timing time
1807	00	RO	U8	05		TPDO8 Communication parameter
	01	RW	U32	80000000		COBID
	02	RW	U8	FF		Transfer Type
	03	RW	U16	0000	0.1ms	Disabled time
	04	RW	U8	00		Reserved
	05	RW	U16	0000	0.1ms	Timing time
1A00	00	RW	U8	01		TPDO1Mapping parameter
	01	RW	U32	60410010		First mapping object
	02	RW	U32	0		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object

	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object
1A01	00	RW	U8	02		TPDO2 Mapping
	01	RW	U32	60410010		First mapping object
	02	RW	U32	60610008		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object
	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object
1A02	00	RW	U8	02		TPDO3Mapping parameter
	01	RW	U32	60410010		First mapping object
	02	RW	U32	60440010		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object
	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object
1A03	00	RW	U8	02		TPDO4 Mapping parameter
	01	RW	U32	60410010		First mapping object
	02	RW	U32	60770010		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object
	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object
1A04	00	RW	U8	02		TPDO5 Mapping parameter
	01	RW	U32	60410010		First mapping object
	02	RW	U32	20540010		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object
	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object
1A05	00	RW	U8	02		TPDO6 Mapping parameter

	01	RW	U32	60410010		First mapping object
	02	RW	U32	20630020		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object
	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object
1A06	00	RW	U8	00		TPDO7 Mapping
	01	RW	U32	0		First mapping object
	02	RW	U32	0		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object
	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object
1A07	00	RW	U8	00		TPDO8 Mapping
	01	RW	U32	0		First mapping object
	02	RW	U32	0		Second mapping object
	03	RW	U32	0		Third mapping object
	04	RW	U32	0		Fourth mapping object
	05	RW	U32	0		Fifth mapping object
	06	RW	U32	0		Sixth mapping object
	07	RW	U32	0		Seventh mapping object
	08	RW	U32	0		Eighth mapping object

Custom Parameter Table

Index (HEX)	Sub-Index (HEX)	Access Permission	Type	Default (DEC)	Map	Unit	Description	Corresponding Function Code
2002	00	WOS	U16	0			Control Mode of Motor: 0: V/F control 1: No PG vector control 1 2: No PG vector control 2 3: PG vector control	A0-09
2003	00	RO	U16	0			Indicating control mode of motor	A0-09
2005	00	RO	U8	3			Frequency limitation parameter	
2005	01	RW	U16	5000		0.01Hz	Max frequency setting	B0-08
2005	02	RW	U16	5000		0.01Hz	Upper limit of frequency	B0-09
2005	03	RW	U16	5000		0.01Hz	Lower limit of frequency	B0-10
2007	00	RO	U8	4			Number of coder parameters	
2007	01	RW	U16	0			Coder Selection" 0: Local coder 1: Extended coder	d6-00
2007	02	RW	U16	1024			Line number of coder	d6-01/ d6-07
2007	03	RW	U16	1000			Numerator in ratio of revolutions	d6-03/ d6-09
2007	04	RW	U16	1000			Denominator in ratio of revolutions	d6-04/ d6-10
2008	00	RW	U16	0		0.01Hz	Frequency of starting	b1-06
2009	00	RW	U16	0		0.1s	Retention time for frequency of starting	b1-07
2013	00	RO	U8	2			Torque limits in speed mode	
2013	01	RW	U16	1800		0.1%	Electric torque limits	
2013	02	RW	U16	1800		0.1%	Braking torque limits	
2021	00	RW	U16	10		0.01s	Torque acceleration/deceleration time	d2-25
2022	00	RO	U8	2			Speed limits in torque mode	
2022	01	RW	U16	5000		0.01Hz	Forward frequency	
2022	02	RW	U16	5000		0.01Hz	Reverse frequency	
2032	00	RWS	U16	10			Positioning completion width	F4-01
2033	00	RWS	U16	200		0.001s	Positioning completion time	F4-02
2034	00	RW	U16	1000		0.001	Position loop gain	F4-03
2050	00	RW	U16	0	Y		Spindle positioning location	F4-05
2051	00	RWS	U16	0	Y		Spindle positioning direction	F4-09
2052	00	RWS	U16	1000	Y	0.01Hz	Spindle positioning speed	F4-10
2053	00	RWS	U16	20		0.1s	Positioning deceleration time of spindle	F4-11

2054	00	RO	U16	0	Y		Positioning pulse count of spindle	U0-47
2060	00	RW	U32	0	Y		Carry quantity setting	F4-17,F4-18
2063	00	RO	U32	0	Y		Current carry quantity	U0-49, U0-50
2100	00	RO	U8	6			Carrying quantity	
2100	01	RO	U16	0			Reserved	
2100	02	RO	U16	0			Reserved	
2100	03	RO	U16	0			Fault code	
2100	04	RO	U16	0	Y	0.01Hz	Operating frequency	U0-00
2100	05	RO	U16	0			Reserved	
2100	06	RO	U16	0	Y	0.01Hz	Feedback frequency of coder	U0-26
2101	00	RO	U8	4			Output quantity	
2101	01	RO	U16	0	Y	0.1A	Output current	U0-04
2101	02	RO	U16	0	Y	V	Output voltage	U0-03
2101	03	RO	U16	0	Y	0.1%	Output power	U0-06
2101	04	RO	U16	0	Y	0.1%	Output torque	U0-05
2102	00	RO	U8	5			Analog input/output	
2102	01	RO	U16	0	Y	0.01V	AI1Input voltage	U0-12
2102	02	RO	U16	0	Y	0.01V	AI2Input voltage	U0-13
2102	03	RO	S16	0	Y	0.01V	AI3Input voltage	U0-14
2102	04	RO	U16	0	Y	0.1%	AO1 Output	U0-15
2102	05	RO	U16	0	Y	0.1%	AO2 Output	U0-16
2103	00	RO	U8	2			Digital quantity input/output	
2103	01	RO	U16	0	Y		State of on-off input terminal	U0-18
2103	02	RO	U16	0	Y		State of on-off output terminal	U0-19
2104	00	RO	U16	0	Y	V	Busbar voltage	U0-02

DS402 Parameter Table

Index (HEX)	Sub-Index (HEX)	Access Permission	Type	Default (DEC)	Map	Unit	Description
6007	00	RW	S16	0	Y		Abort connection option code 0:No action; 1:Malfunction 2:Disable Voltage; 3:Quick Stop
603F	00	RO	U16	0	Y		Error Code
6040	00	RW	U16	0	Y		Control Word
6041	00	RO	U16	0	Y		Status Word
6042	00	RW	S16	0	Y	RPM	VI Target Velocity
6043	00	RO	S16	0	Y	RPM	VI Velocity Demand
6044	00	RO	S16	0	Y	RPM	VI Control Effort
6046	00	RO	U8	0			Number of Parameters
6046	01	RW	U32	0	Y		VI Velocity Min Amount
6046	02	RW	U32	0	Y		VI Velocity Max Amount
604F	00	RW	U32	60	Y	0.1s	VI Ramp Function Time (when d2-00 is set to “1”, the unit is 0.1s and other values are as shown in Function Code b2-00)
6050	00	RW	U32	60	Y	0.1s	VI Slow Down Time (when d2-00 is set to “1”, the unit is 0.1s and other values are as shown in Function Code b2-00)
6051	00	RW	U32	60	Y	0.1s	VI Quick Stop Time (when d2-00 is set to “1”, the unit is 0.1s and other values are as shown in Function Code b2-00)
605A	00	RW	S16	2			Quick Stop Option Code 0:Disable drive function 1:Slow down on slow down ramp 2:Slow down on quick stop ramp 5:Slow down on slow down ramp and stay in QUICK STOP 6:Slow down on quick stop ramp and stay in QUICK STOP
605B	00	RW	S16	0			Shut down Option Code 0: Disable drive function 1: Slow down with slow down ramp disable of the drive function
605C	00	RW	S16	1			Disable Operation Option Code 0: Disable drive function 1: Slow down with slow down ramp and then disabling of the

							drive function
605D	00	RW	S16	1			Halt Option Code 0: Disable drive, Motor is free to rotate 1: Slow down on slow down ramp 2: Slow down on quick stop ramp
605E	00	RW	S16	0			Fault reaction option code 0: Disable drive, Motor is free to rotate 1~4:Reserved
6060	00	WO	S8	2	Y		Modes Of Operation 2: Velocity Mode 4:Profile Torque Mode -1: Simple Feed -7: Motor Spindle Orientation
6061	00	RO	S8	2	Y		Modes Of Operation Display
6071	00	RW	S16	0	Y	0.1%	Target Torque
6072	00	RW	U16	1800	Y	0.1%	Max Torque
6077	00	RO	U16	0	Y	0.1%	Torque Actual Value
6078	00	RO	U16	0	Y	0.1%	Current Actual Value
6079	00	RO	U16	0	Y	mV	DC Link Circuit Voltage
6087	00	RW	U32	0	Y	0.1%/s	Torque Slope
6088	00	RW	S16	0	Y		Torque Profile Type 0:Linear ramp 1:sin^2 ramp(Reserved)
6410	00	RO	U8	6			Number of Motor Parameters
6410	01	RO	U16			0.1KW	Rated power of motor
6410	02	RO	U16			V	Rated voltage of motor
6410	03	RO	U16			0.1A	Rated current of motor
6410	04	RO	U16			0.01Hz	Rated frequency of motor
6410	05	RO	U16				Poles of motor
6410	06	RO	U16			RPM	Rated speed of motor
6502	00	RO	U32	81000AH			Supported Drive Modes
6510	00	RO	U8	3			Number of Driver Parameters
6510	01	RO	U16			0.1KVA	Rated capacity of driver
6510	02	RO	U16			V	Rated voltage of driver
6510	03	RO	U16			0.1A	Rated current of driver

Appendix 2: Fault Code

Fault Code.	Faults	Description	CANopen Fault Code (HEX)	Fault Buffer Bit of CANopen (1001H)
1	oC1	Accel overcurrent	2310	1
2	oC2	Constant speed overcurrent	2310	1
3	oC3	Decel overcurrent	2310	1
4	ov1	Accel overvoltage	3210	2
5	ov2	Constant speed overvoltage	3210	2
6	ov3	Decel overvoltage	3210	2
7	FAL	Module protection	5410	5
8	tUN	Parameter identification failured	7120	7
9	oL1	Drive overloaded	3230	7
10	oL2	Motor overloaded	3230	7
11	CtC	Current detection abnormal	2300	1
12	GdP	Output ground short-cuirt protection	2240	1
13	ISF	Input power supply abnormal	3100	2
14	oPL	Output phase loss	3130	2
15	oL3	Inverter mudule overload protection	4310	3
16	oH1	Heat sink thermal protection	4310	3
17	oH2	Motor thermal protection (PTC)	7120	1
18	oH3	Module temperature detection undisconnected	7300	7
19	CLL	Encoder disconnected	7300	7
20	EC1	Abnormal connection of Expansion Card 1	7300	7
21	EC2	Abnormal connection of Expansion Card 2	7300	7
22	dLC	Abnormal connection of driver line	5441	7
23	TEr	Function conflict of analog terminal	6100	7
24	PEr	External equipment fault	9000	7
26	to2	Consecutive running time out	FF00	7
27	to3	Accumulative running time out	FF01	7
28	SUE	Power supply abnormal at	3200	2

		running		
29	EPr	Read/write fault of EEPROM	5530	5
30	CCL	Contactor suction fault	5400	7
31	TrC	Port communication abnormal	7500	4
32	PdC	Keypad communication abnormal	7500	4
33	CPy	Parameter copy fault	5530	7
35	SFt	Software version compatibility failure	6100	7
36	CPU	CPU Interference fault	5300	7
37	oCr	Benchmark protection	5115	7
38	SP1	5V Power supply overranging	5113	5
39	SP2	10 Power supply overranging	5114	5
40	AIP	AI input overranging	3000	7
41	LoU	Undervoltage protection	3220	2
42	oSP	Over-speed fault	7310	7
43	SPL	Speed misalignment is large	7310	7
45	Plo	PID detection overranging	5430	7
46	CAN	Internal or external communication fault	8100	4

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